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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/542,550	RAMAKRISHNA, NATARAJAN	
	Examiner	Art Unit	
	HENG M. CHAN	4181	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-27* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-27* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *18 July 2005* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *07/18/2005*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Status of Application

Claims 1-27 are pending and examined on the merits.

Drawings

The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, **the "hydraulic power means consisting of a hydraulic pack and the hydraulic cylinders with suitable sealing mechanism" must be shown or the feature(s) canceled from the claim(s).** No new matter should be entered.

The drawings are objected to under 37 CFR 1.83(a) because they **fail to show "A hydrogen gas inlet (31) with 'T' connection (36a, 36b, 36c) originating from various outlets (1) of the cylinders of the system as shown in Fig. 1 as described in the specification (Page 5, line 27-29).** Any structural detail that is essential for a proper understanding of the disclosed invention should be shown in the drawing. MPEP § 608.02(d).

Figure 1 should be designated by a legend such as --Prior Art-- because only that which is old is illustrated. See MPEP § 608.02(g).

The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they include **the following reference character(s) not mentioned in the description: 5, 8, 15, and 26 in Figure 2; 26a and 26b in Figure 3; and 34 and 35 in Figure 4.**

Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Specification

Applicant is reminded of the proper language and format for an **abstract** of the disclosure. The form and legal phraseology often used in patent claims, such as "means" and **"said," should be avoided**. The abstract should describe the disclosure sufficiently to assist readers in deciding whether there is a need for consulting the full patent text for details.

The disclosure is objected to because of the following informalities:

Page 5, line 26 recites "time and change over switch (30 & 31) and line 27 of the same page recites "a hydrogen gas inlet (31)." It is unclear what 31 does.

Page 5, line 27-29 recites "A hydrogen gas inlet (31) with 'T' connection (36a, 36b, 36c) originating from various outlets (1) of the cylinders of the system as shown in Fig. 1." However, the mentioned details are not present in Fig. 1.

Page 7, line 1 contains two typos of the word "of" and one of the first "the."

Page 8, lines 10-11 contain a grammatical error as they recite "Yet another embodiment of the method wherein the aluminum that is used is powder form is in the range of 5-50%..."

Page 8 contains two duplicate paragraphs: lines 23-24 repeat 16-17 and lines 25-26 repeat 14-15, respectively.

Page 8, line 19 contains a mistake that "controller" should be "controlled."

Page 9, lines 4-6 contain a grammatical error as they recite "An embodiment of the present invention, wherein the metal content for metal hydride is selected from the alkali metals selected include sodium..."

Appropriate corrections are required.

Claim Objections

Claim 1(c) recites "a lid" as opposed to "the lid" as claim 1(a) already mentions "a lid," assuming that the cylinder has only one lid.

Claim 7 is objected to because it is dependent on itself.

Claim 23 contains a grammatical error: "the method as claimed in claim 20, wherein the aluminum that is used is powder form is in the range of 5-50%..."

Claim 26 contains a mistake that "controller" should be "controlled."

Appropriate corrections are required.

Claim Rejections - 35 USC § 112

112 1st

The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claim 1 is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. The limitation is "a motion transmitting element mounted on the ramming means connected to outer baffles to provide a corresponding rotatable action to the container."

Claim 10 is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had

possession of the claimed invention. The limitations are "a hydraulic pack" and "hydraulic cylinders."

Claim 17 is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. The limitation is that "the ramming means can be directed to crush the encapsulated metal hydride shells in any selected cylinder connected to the system."

112 2nd

The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

There is insufficient antecedent basis for the following limitations in the respective claims.

Claim 1(g) recites the limitation "the pair of containers."

Claims 10 recites "said hydraulic power means" and "the hydraulic cylinders."

Claim 18 recites "the intervening gaps."

Claim 19 recites "the hydraulic power means."

Claim 22 recites "the plurality of cylinders."

Claim 23 recites "the aluminum."

Claim 27 recites "both low and high density encapsulated metal hydride shells."

Claim 19 is also rejected under 35 U.S.C. 112, second paragraph, as being incomplete for omitting essential structural cooperative relationships of elements, such omission amounting to a gap between the necessary structural connections. See MPEP § 2172.01. The omitted structural cooperative relationships are: the hydraulic power means having a hydraulic seal is placed at the bottom of the system... to have a multi-container dispensing system.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1, 4-9, 11-12, 14, 16-18, 21-22, and 27 are rejected under 35 U.S.C. 103(a) as being unpatentable over US Patent no. 5,817,157 to Checketts, in view of US Patent Application Publication no. 2004/0047801 by Petillo et al., US Patent no. 4,543,246 to Houser, US Patent no. 7,181,906 to Dalla Betta et al., and US Patent no. 4,466,808 to Koog.

Regarding claim 1, Checketts teaches a hydrogen generation system comprising:

- At least a sealed and replaceable cylindrical housing **52** filled with water having a top plate **55,** mounted vertically on a bottom cover **54** (Figures 5 and 7-9; column 10, lines 3-8 and lines 23-25);

- The cylindrical container **52** bottom portion stores encapsulated spherical metal hydride pellets and is refilled by a straight refilling tube **105** (Figures 5-6). In addition, a bank of cells that contains individual coated pellets formed of sodium or another suitable alkali metal or metal hydride (Figure 1; column 3, lines 50-58) is preferably arranged to be easily and quickly removed, when expended, and replaced with a fully charged system (column 4, lines 38-41).

- A top cover **55** arranged for closing over the cylinder top end, in sealing engagement therewith and may be removable for fitting the hydrogen generator **51** therein (column 10, lines 3-8); the hydrogen generator **51** includes a spherical pellet loading arrangement and is installed inside the cylindrical housing **52** (Figures 5 and 6). That is, the top cover **55** provides "an inlet means for encapsulated metal hydride and water."

- A bottom plate **81** disposed at the bottom end of the cylinder is fixed to the inner surface of the cylinder as shown (Figures 5 and 7-9).

- The bottom plate **81** has a feed tube **91** that provides a passage for the spherical pellets to float upwardly and out from a top end **91b** thereof and into a reactor chamber **92a** in the cylinder (Figures 7-9; column 11, lines 34-37).

- A reactor piston **92** disposed at the end of the passage extends into the reactor chamber **92a** ("a disintegrating site"), urging the spherical pellet therein against the sharp edge **95** of the reactor blade **94** to cut the pellet in half. The two pellet halves then float out into the water (Figure 9; column 11, lines 41-49).

- A hydrogen outlet **61** disposed on the top cover **55** (Figure 7).

- A computer system to control the operations of the system (column 4, lines 5-8 and 32-41).

Checketts does not expressly teach a rotatable container fixed to inner surface of the cylinder on both the sides by supporting rings with rollers.

Petillo et al. (US Patent Application no. 10/115,269) also teaches about the generation of hydrogen gas by hydrolysis reactions of many complex metal hydrides, including sodium borohydride (page 1, paragraphs 1 and 2). Petillo et al. teaches a rotary cylinder as a dispensing device that dispenses predetermined amounts of a solid component in granule, pellets and powder forms in response to a control signal indicating a need for generating more hydrogen (page 1, paragraph 7).

It would have been obvious to one of ordinary skill in the art at time of invention would have used a rotatable container fixed to the inner of the cylinder on both the sides by supporting rings with rollers in Checketts' hydrogen generation system, motivated by Petillo et al.'s teaching that rotational cylinder or container driven by a motor or air-driven wheel (which works similarly to supporting rings with rollers) rotates one or more

times so that it provides a predetermined amount of the solid component to combine with liquid component in a chamber (page 4, paragraph 38) and thus controls the rate of the reaction.

Checketts does not expressly teach a lid having a moist separation mesh.

However, it would have been obvious to one of ordinary skill in the art at time of invention to have used a lid having a moist separation mesh in Checketts' hydrogen generation system, motivated by the fact that the metal hydride is reactive with the moisture in the air and a moist separation mesh is useful in preventing such an unwanted reaction.

Checketts does not expressly teach a slide base member fixed to the inner surface of the cylinder on both sides by supporting rings.

Houser (US Patent no. 4,543,246) also teaches a method and apparatus for producing hydrogen gas continuously by a reaction of aluminum metal balls with a sodium hydroxide solution (abstract; column 1, lines 57-63). Houser teaches that the balls rolls by gravity through ball opening **18**, down ball return guide **19**, through ball receiver chamber **21**, passage **26** to a ball feeder **16**, and that undersized balls automatically fall into a ball slot gauge then a chute **23** located in the path of the balls travelling through the chamber **21** (Figure; column 3, lines 47-52 and 10-13).

It would have been obvious to one of ordinary skill in the art at time of invention to have turned Checketts' hydrogen generation system up-side-down so that the

container of the metal hydride pellets would be on the top and used a slider base member to provide a passage or a slider path to transmit the encapsulated metal hydride pellets from the container into the cylinder, motivated by Houser's demonstration that balls rolling by gravity from one chamber to the next simplifies the machinery of the hydrogen gas generator and that the balls can be guided into a desired location by directing means such as the down ball return guide, the inclining path (like "the slider path"), and the passage. The use of supporting rings on the slider base member, as explained before using the teaching of Petillo et al., provides rotational means for the container so that a predetermined amount of the solid component from the container can be combined with the liquid component in the reaction chamber.

Checketts does not teach expressly a plurality of baffles disposed both inside and outside periphery of the rotatable container.

Dalla Betta et al. (US Patent no. 7,181,906) relates to devices and method for generating H_2 and CO in an O_2 containing gas stream and those for reduction of NOx emissions from lean burn engines (abstract). Dalla Betta et al. employs baffles and partitions inside a fuel processor unit to direct the desired amount of flow through the rotating fuel processing catalyst (Figure 5; column 14, lines 12-33).

It would have been obvious to one of ordinary skill in the art at time of invention to have used a plurality of baffles disposed on the inside of the rotatable container in Checketts' hydrogen generation system, in order to direct the desired amount of

encapsulated metal hydride shells through the rotating container, just as the gas stream is directed by baffles to flow through the rotating fuel processing catalyst taught by Dalla Betta et al.

Koog (US Patent no. 4,466,808) relates to an apparatus and a method of cooling hot gases containing carbon monoxide, hydrogen, and non-gaseous components (column 1, lines 8-41). Koog employs a dip tube bearing on the outer surface a plurality of baffles that impart to assist in heat transfer and to coalesce the liquid (and solids contained therein) as the gas exits the apparatus (Example III).

It would have been obvious to one of ordinary skill in the art at time of invention to have used a plurality of baffles disposed on both the inside and outside of the rotatable container in Checketts' hydrogen generation system, not only to direct the desired amount of encapsulated metal hydride shells through the rotating container by inner baffles as demonstrated by Dalla Betta et al., but also cools the hot hydrogen gas and possibly condenses water vapors as the reaction generates a large amount of hydrogen gas and heat at the same time as suggested by Koog.

Regarding claims 4 and 22, Checketts does not expressly teach using optionally a plurality of cylinders and containers connected in series for hydrogen production, storage and dispensation.

Regardless of the way the plurality of cylinders and containers are connected, it would have been obvious to one of ordinary skill in the art at time of invention to have used a plurality of cylinders and containers in Checketts' system in order to maximize

the efficiency of producing, storing, and dispensing hydrogen gas as the number of systems increases.

Regarding claim 5, Checketts teaches that the hydrogen generation system is made of steel (column 5, lines 16-20).

Regarding claim 6, Checketts teaches a movable reactor piston **92** and a reactor chamber **92a** that facilitate the disinegraton of the metal hydride pellets (Figures 7-9).

Regarding claims 7 and 21, Checketts teaches that the pellets are formed of alkali metal or metal hydride, for example, sodium (column 2, lines 52-54; column 3, lines 50-52). The pellets are coated with aluminum or like metal (column 3, lines 13-15).

Regarding claim 8, Checketts teaches that the pellets are shaped into a sphere, cube, or like shape (column 3, lines 50-52).

Regarding claim 9, Checketts teaches that the pellets are coated with a flexible plastic, such as high density polyethylene (column 4, lines 45-48).

Regarding claim 11, Checketts teaches that a bank of cells that contains individual coated pellets is preferably arranged to be easily and quickly removed, when expended, and replaced with a fully charged system (column 4, lines 38-41).

Regarding claim 12, Checketts teaches that the control panel is a computer (column 4, lines 32-41).

Regarding claim 14, Checketts does not expressly teach that baffles are used to provide an uninterrupted and selected flow of encapsulated metal hydride materials to the disintegration site.

Dalla Betta et al. (US Patent no. 7,181,906), as explained above, relates to devices and method for generating H_2 and CO in an O_2 containing gas stream and those for reduction of NOx emissions from lean burn engines (abstract). Dalla Betta et al. employs baffles and partitions inside a fuel processor unit to direct the desired amount of flow through the rotating fuel processing catalyst (Figure 5; column 14, lines 12-33).

Therefore, it would have been obvious to one of ordinary skill in the art at time of invention to have used baffles in Checketts' hydrogen generation system and provided an uninterrupted and selected flow of encapsulated metal hydride materials to the disintegration site, as motivated by Dalla Betta et al.'s demonstration that as the exhaust gas stream flows continuously through the rotating fuel processing catalyst (it would not have been called a stream otherwise), the baffles provide an uninterrupted and selected flow of gas through the rotating fuel processing catalyst. Similarly, the skilled artisan would have obtained predictable results using baffles in Checketts' system to provide an uninterrupted and selected flow of encapsulated metal hydride materials to the disintegration site.

Regarding claims 16 and 18, Checketts teaches that the coated pellets react with water in the cylinder to produce hydrogen that may be contained within the same housing (column 4, lines 51-54). That is, hydrogen gas is stored in the cylinder as the pellets are being disintegrated. Also, the intervening gaps among the pellets make up part of the cylinder.

Regarding claim 17, Checketts teaches that the reactor piston **92** can be directed to crush the metal hydride pellet in response to a decrease in hydrogen pressure in any cylinder through a detailed mechanism disclosed in text and in figures (from column 10, line 38 to column 12, line 33; Figures 7-9).

Regarding claim 27, low and high density encapsulated metal hydride shells are considered to correspond to the small or large content of aluminum in the encapsulated shells of metal hydride, for example, sodium hydride. Checketts does not expressly teach using low and high density encapsulated metal hydride shells.

However, it would have been obvious to one of ordinary skill in the art at time of invention to have used both low and high density encapsulated metal hydride shells in Checketts' hydrogen generation system, motivated by the fact that when balls of metal hydride or metal roll by gravity as demonstrated by Petillo et al., density of the ball becomes insignificant and so the skilled artisan would have chosen low or high density metal hydride or metal balls depending on the desired amount of aluminum within.

Claims 2, 3, 13, 15, 20, and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Checketts, in view of Petillo et al., Houser, Dalla Betta et al., and Koog as applied to claims 1, 4-9, 11-12, 14, 16-18, 21-22, and 27 above, further in view of US Patent no. 2,721,789 to Gill et al.

Regarding claims 2 and 13, Checketts does not expressly teach using a valve at the bottom end to control the flow of the water, disintegrated shells along with by-products or that the outlet valve is sealed or opened only during refilling.

Gill et al., who also discloses a cylindrical hydrogen generator using the reaction of water with a measured dry charge of finely divided aluminum and flake caustic soda (sodium hydroxide), teaches using chemical residue outlet valve **20** threaded to a flushing pipe **18** in communication with a chemical residue discharge tube **24** (Figure 1; column 3, lines 46-51).

It would have been obvious to one of ordinary skill in the art at time of invention to have added a valve at the bottom end to control the flow of water and waste in Checketts' hydrogen generation system, motivated by Gill et al.'s demonstration of the ease to flush the system and remove waste at the bottom end of the system. It would have also been obvious to one of ordinary skill in the art at time of invention to have kept the outlet valve sealed at all times except for draining, flushing, or refilling, motivated by the fact that hydrogen gas pressure inside the cylinder during the reaction is greater than atmospheric pressure and opening the valve during the reaction will cause the reactants, along with the byproducts, to spill.

Regarding claim 3, Checketts teaches the top cover **55** has a hydrogen outlet **61** (Figure 7).

Checketts does not expressly teach that the lid of the cylinder is an elevated hollow lid or does the lid consist of rupture diaphragms.

Gill et al. teaches that the top plate 14 has some space below it for hydrogen pressure measurement by a pressure gauge 84, which resembles an elevated hollow lid only flatter (Figure 1). Gill et al. also teaches that an additional exhaust pipe 92

communicates through a diaphragm safely valve 94 directly with the space immediately above the chemicals in the chemical reaction chamber 16 (Figures 1 and 4).

It would have been obvious to one of ordinary skill in the art at time of invention to have used a lid that is an elevated hollow lid consisting of hydrogen outlet and rupture diaphragms in Checketts' hydrogen generator, motivated by the fact that the chemical reaction generates hydrogen gas which exerts pressure to the inside of the apparatus and thus some space below the lid or top plate does not only allow storage of hydrogen gas produced during the chemical reaction but also enable the gas pressure measurement by a pressure gauge, the outlet, and rupture diaphragms for added safety precaution.

Regarding claim 15, Checketts teaches that the reactor piston 92 urges the pellets against the sharp edge 95 to be cut in half (Figure 9).

Checketts does not expressly teach that the small and tiny debris are collected at the bottom of the container for easy disposal and recycling.

However, Gill et al. teaches that the chemical residue outlet valve **20** threaded to a flushing pipe **18** in communication with a chemical residue discharge tube **24** (Figure 1; column 3, lines 46-51).

It would have been obvious to one of ordinary skill in the art at time of invention to have used, in Checketts' system, the ramming means to crush the metal hydride shells to increase the contact of the metal hydride with water and collected the debris at the bottom of the container as demonstrated by Gill et al.

Regarding claim 20, Checketts teaches or implies the following method of using the hydrogen generation system comprising the step of:

- Mounting the sealed cylindrical housing **52** on a bottom cover **54** filled with water and a container with encapsulated metal hydride pellets (Figures 7-9);
- Directing the encapsulated metal hydride pellets through feed tube **91** into the reactor piston **92** by letting the pellets flow upwardly and crushing the desired quantities of encapsulated metal hydride pellets to disintegrate (Figures 7-9);
- Dispersing the metal hydride into water (Figure 9);
- Reacting the metal hydride with water to produce hydrogen (Figure 9);
- Releasing the hydrogen through outlet 96 at the top of the cylinder; and

Checketts does not expressly teach that directing the encapsulated metal hydride into the ramming means is achieved by means of baffles.

Dalla Betta et al. (US Patent no. 7,181,906) utilizes baffles to direct the desired amount of flow through the rotating fuel processing catalyst as discussed above (Figure 5; column 14, lines 12-33).

Therefore, it would have been obvious to one of ordinary skill in the art at time of invention to have added the step of directing the encapsulated metal hydride into the ramming means is achieved by means of baffles when using Checketts' hydrogen generation system, in order to direct the desired amount of encapsulated metal hydride shells through the rotating container, just as the gas stream is directed by baffles to flow through the rotating fuel processing catalyst taught by Dalla Betta et al.

Checketts does not expressly teach the step of collecting the disintegrated pieces and the byproducts at the bottom of the container.

Gill et al., as explained above, also discloses a cylindrical hydrogen generator having a chemical residue outlet valve **20** threaded to a flushing pipe **18** in communication with a chemical residue discharge tube **24** (Figure 1; column 3, lines 46-51).

Therefore, it would have been obvious to one of ordinary skill in the art at time of invention to have added the step of collecting the disintegrated pieces and the byproducts at the bottom of the container when using Checketts' hydrogen generation system, in order to discard waste at the bottom of the container through an outlet described by Gill et al.

Regarding claim 23, the aluminum is considered to be a powder component of the encapsulated metal hydride shells in a weight percentage of 5-50%. Checketts teaches that the pellets have a thin protective aluminum shell (column 9, line 31). Checketts also teaches that the aluminum greatly increases the hydrogen production by the following reactions (column 9, lines 32-54):

$$Na + H_2O \rightarrow NaOH + \tfrac{1}{2} H_2O$$

$$2Al + 2NaOH \rightarrow 2NaAlO_2 + H_2$$

$$\text{Overally, } Na + Al + H_2O \rightarrow NaAlO_2 + 2H_2$$

Checketts does not specifically disclose the form of aluminum used or the percentage of aluminum.

However, Gill et al. teaches that finely divided aluminum (which could be powdery) and sodium hydroxide, ordinarily in the ratio of approximately 6 to 9 by weight (about 40% Al) react in water to produce hydrogen: $2Al + 2NaOH + 2H_2O$ à $2NaAlO_2 + 3H_2$ (column 3, lines 52-57).

It would have been obvious to one of ordinary skill in the art at time of invention to have used aluminum in the claimed range in Checketts' hydrogen generation system, motivated by the teachings of Checketts and Gill et al. that aluminum reacts with water and sodium to greatly increase hydrogen production.

Claims 10 and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Checketts, in view of Petillo et al., Houser, Dalla Betta et al., and Koog as applied to claims 1, 4-9, 11-12, 14, 16-18, 21-22, and 27 above, further in view of US Patent no. 5,356,274 to Lee.

Regarding claims 10 and 19, the hydraulic power means is considered to consist of a hydraulic seal to prevent leakage from the system. Checketts does not expressly teach using a hydraulic power means or hydraulic seal.

Lee discloses the use of a hydraulic seal in a self-suction unit filled with a liquid (Figure 4). Lee teaches that the hydraulic seal of the liquid in the storage tank under the suction pipe will cause the negative pressure to draw liquid from the storage tank to the self-suction barrel through the suction pipe (column 2, lines 7-19).

It would have been obvious to one of ordinary skill in the art at time of invention to have used a hydraulic power means having a hydraulic seal to prevent leakage from

Checketts' hydrogen generation system, motivated by Lee's teaching that the hydraulic seal causes a negative pressure which prevents liquid from leaking the system.

Claims 24-26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Checketts, in view of Petillo et al., Houser, Dalla Betta et al., and Koog and further in view of Gill et al. as applied above, further in view of US Patent no. 6,800,258 to Andersen et al.

Regarding claim 24, Checketts teaches that NaOH and $NaAlO_2$ are produced as byproducts (column 3, lines 32-54 and formulas therein).

Checketts does not specifically teach that alumina is one of the byproducts.

Andersen et al. also relates to the production of hydrogen gas and heat from aluminum, water, and sodium hydroxide as catalyst (column 2, line 66 to column 3, line 4). Andersen et al. teaches the following equation (column 5):

$$2Al + 3H_2O \rightarrow Al_2O_3 + 3H_2$$

Catalyst = NaOH

It would have been obvious to one of ordinary skill in the art at time of invention to have produced NaOH and alumina by using Checketts' hydrogen generation system, motivated by the teaching of Checketts that NaOH is produced and the teaching of Andersen et al. that alumina (Al_2O_3) is produced from the reaction between aluminum, sodium, and water.

Regarding claim 25, Checketts does not specifically teach that the reaction condition is exothermic and that it provides the desired temperature range for the formation of alumina.

Andersen et al. discloses that the reaction between alumina and water in the presence of catalytic sodium hydroxide produces a large amount of heat and hydrogen gas (column 4, lines 58-62). Andersen et al. also teaches the formation of alumina (column 5, formula).

It would have been obvious to one of ordinary skill in the art at time of invention to have used the exothermic reaction ncondition to provide the desired temperature range for the formation of alumina in Checketts' hydrogen generation system, motivated by the teaching of Andersen et al. that alumina and heat are produced, in addition to hydrogen gas, as a result of the reaction between aluminum and water.

Regarding claim 26, Checketts teaches that the production of hydrogen gas is controlled by a static pressure source shown as a cylinder **65** (Figures 5-9; from column 10, line 38 to column 4, line 11).

Checketts does not expressly teach that the reaction of metal hydride takes place under controlled pressure and temperature.

Andersen et al., however, teaches that the experiments were carried out at a room temperature 21° C and an atmospheric pressure of 758 mm of Hg (column 5, lines 28-29).

It would have been obvious to one of ordinary skill in the art at time of invention to have controlled the pressure and temperature of the reaction in Checketts' hydrogen

generation system, motivated by the fact that the reaction of metal hydride with water increases the hydrogen gas pressure and temperature inside the system as the reaction releases hydrogen gas and heat in large quantities. The pressure and temperature of the reaction must be controlled in order to avoid explosion or destruction of the apparatus as a result of high pressure or temperature.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to HENG M. CHAN whose telephone number is (571)270-5859. The examiner can normally be reached on Monday to Friday, 8:00 am EST to 5:30 pm EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Vickie Kim can be reached on (571)272-0579. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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HMC

/Vickie Kim/

Supervisory Patent Examiner, Art Unit 4181